



**2016 Water Quality Report**  
**Fresh Pond Reservation: Class B Ponds, Cambridge, MA**

The Cambridge Water Department monitors three ponds on the Fresh Pond Reservation: Little Fresh Pond, Black's Nook, and North Pond. These shallow ponds have no surface water connections to the Fresh Pond water supply reservoir, and as such, they have negligible influence over water quality in the Cambridge water supply. Gated pipes between Little Fresh Pond and Fresh Pond Reservoir are kept closed under normal operating conditions, but are opened as needed in controlled conditions to supply irrigation water to Little Fresh Pond. All three ponds drain the City of Cambridge Municipal Golf Course and the reservation's wooded areas, with overflow connections to the City's storm drain system. Stormwater in the developed areas surrounding the reservation is diverted away to further protect drinking water quality. Groundwater communication between the ponds, the surrounding developed area, and the reservoir is minimized by keeping the reservoir higher than the water table.



**Figure 1: Fresh Pond Reservation Waterbodies**



This report includes data collected from the reporting period of April 1, 2016 to March 31, 2017. Table 1 also includes samples collected on March 1, 2016 during the previous reporting period. These sample results had not been fully analyzed by the publication date of the 2015 report and are therefore included in Table 1.

Massachusetts Class B waters are designated for fish, other aquatic life and wildlife habitat, and for primary and secondary contact recreation. Class B water quality standards include numeric and narrative standards for dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor. In this study period, three dry-weather water quality sampling events were conducted. Samples were taken at the surface of each pond using extended poles or hand-grabbing samples after wading in from the shoreline. *In-situ* parameters were taken with a calibrated multi-probe concurrently with grab samples.

## 2016 Results

**Black's Nook**- Listed in the 2014 Massachusetts Integrated List of Waters as a Category 5 impaired water for secchi disk transparency, nutrient/eutrophication biological indicators, and non-native aquatic plants. Historic and recent chlorophyll-*a* (Chl-*a*) results are consistent with Carlson's trophic state index (TSI) for a highly-productive, eutrophic pond. Median and average TSI numbers during this period were in the eutrophic and hypereutrophic range (figure 2).

### 1. Dissolved Oxygen

- There was one violation of the Class B standard for dissolved oxygen ( $\geq 5$  mg/L) observed in surface samples during the reporting period.

Date	Time	Result*
7/27/16	9:41 am	3.6 mg/L

\*The multi-probe sensor took an unusually long period of time to stabilize. Two additional readings were taken at 12:04 and 12:08 pm on 7/27/2016. The DO concentration for the average of the three readings was 5.77 mg/L which does not violate the Class B water quality standard.

### 2. Temperature

- No violations associated with warm-water fisheries were observed. Class B standard requires temperatures not to exceed 28.3°C.

### 3. pH

- No violations observed;  $6.5 < \text{pH} < 8.3$ .



## 2016 Fresh Pond Reservation Class B Waters

### 4. Bacteria

- One *E. coli* sample violated the Class B water quality for bacteria (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample.

Date	Time	Result
7/27/16	9:41 am	291 MPN/ 100 mL

### 5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for Black's Nook.

### 6. Color and Turbidity

- There are no numeric criteria for color and turbidity, however the standard dictates water bodies must be free from aesthetically objectionable conditions. Eutrophic state and water clarity discourage swimming and boating.

### 7. Taste and Odor

- No objectionable odors observed.

### 8. Oil and Grease

- No samples taken, but no visible sheens observed.

**Little Fresh Pond-** Not assessed as part of the Massachusetts Integrated List of Waters survey. Chl-*a* results were consistent with Carlson's trophic state index of a highly-productive, eutrophic and hypereutrophic pond (figure 2). Shoreline restoration, vegetated buffers, and a pretreatment swale and forebay system were completed in 2008. Specific conductance readings and sodium and chloride concentrations are consistently among the highest of the reservation ponds. The values for these parameters closely mirror those of Fresh Pond Reservoir, reflecting the hydrological connectivity via pipes and groundwater communication (table 1). No violations of Class B water quality standards were observed during the 2016-2017 study period.

**North Pond-** Not assessed as part of the Massachusetts Integrated List of Waters survey. During the growing season, this pond fills with floating and rooted aquatic plants. The 2016-2017 chl-*a* results were consistent with Carlson's trophic state index for a highly-productive, eutrophic and hypereutrophic pond (figure 2). North Pond had the highest average and median TSI readings and was the most eutrophic of the three ponds (figure 2).



### 1. Dissolved Oxygen

- One violation of the Class B standard for dissolved oxygen was observed on 7/27/2016. The pond was overrun with dense aquatic vegetation and associated organic matter. Aerobic microbial respiration from decomposition of organic matter, which was abundant due to the plant growth, likely contributed to the near anoxic conditions in the pond.

Date	Time	Result
7/27/16	10:12 am	0.29 mg/L

### 2. Temperature

- No violations associated with warm-water fisheries were observed; temperature remained below 28.3 degrees C.

### 3. pH

- The pH of one water quality sample measured in the lab was outside the range of the Class B standard of  $6.5 < \text{pH} < 8.3$ . However, the pH reading from the *in situ* water quality probe was 7.2, which does not violate the Class B water quality standard. The large difference between the *in situ* probe pH and lab pH may be due plant or algal activity causing highly localized differences in water chemistry.

Date	Time	Result
7/27/16	10:12 am	8.75

### 4. Bacteria

- No violations observed.

### 5. Solids

- There are no numeric standards for solids. Visual observations suggest that neither floating nor suspended solids are a source of impairment for the pond, with the exception of the excessive vegetation and turbidity during the summer months discussed below.

### 6. Color and Turbidity

- Eutrophic state and water clarity discourage swimming and boating; during the summer, North Pond becomes choked with aquatic vegetation and suspended organic matter.





## 2016 Fresh Pond Reservation Class B Waters

- Photographs A and B show the dense aquatic vegetation in North Pond on 7/27/2016. Photograph C was taken after the growing season on 11/2/2016 when aquatic vegetation and suspended organic matter were less problematic.



**Photograph A: Zoomed-in view of area where sample was collected on 7/27/2016. Dense vegetation and suspended organic matter dominated the sample area.**



**Photograph B: View of North Pond sampling location looking southeast on 7/27/2016. Dense aquatic vegetation and suspended organic matter were present throughout the pond.**





**Photograph C: View of North Pond sampling location looking southeast on 11/2/2016. The dense aquatic vegetation and suspended organic matter had considerably decreased.**

7. Taste and Odor

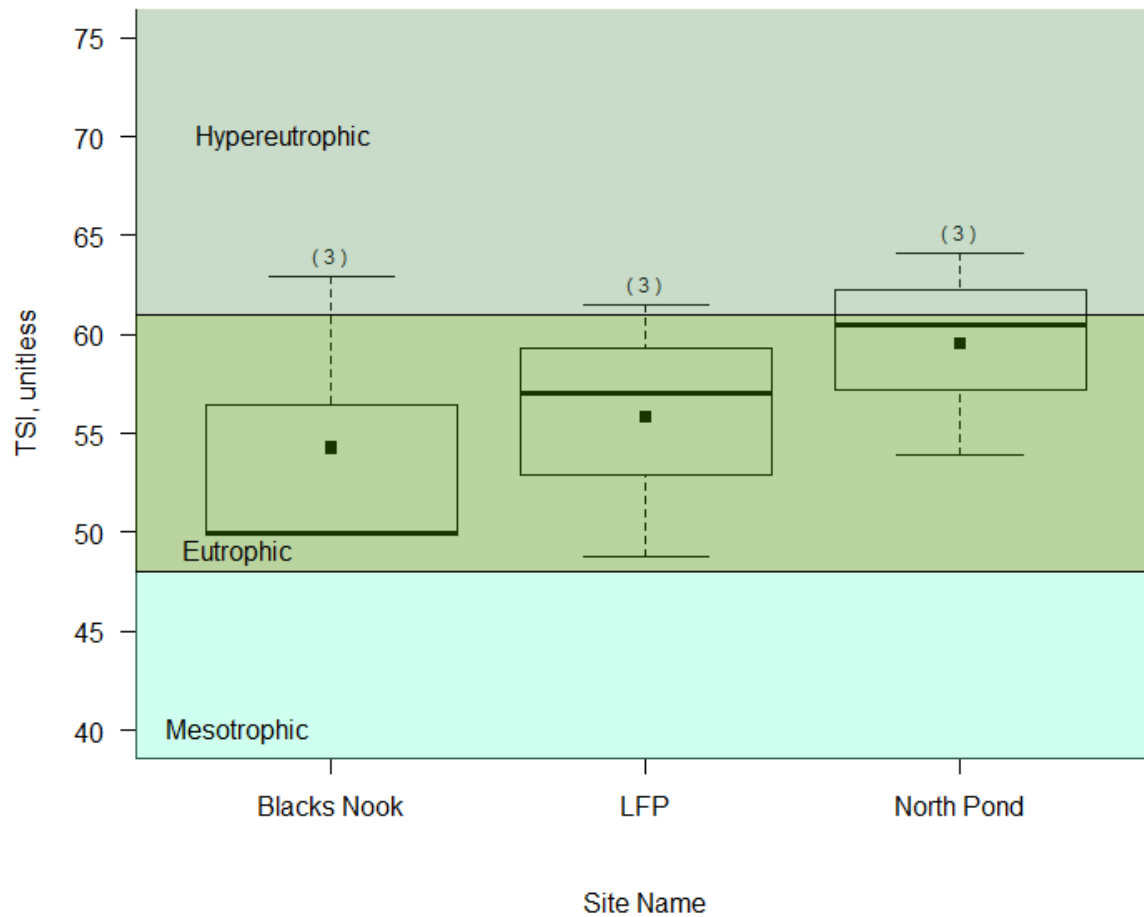
- No objectionable odors observed.

8. Oil and Grease

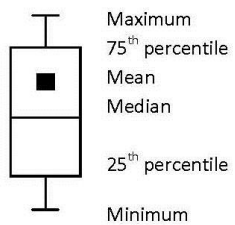
- No samples taken, but no visible sheens observed.



**Figure 2: Reservation Pond Trophic State Index from Chlorophyll-*a*, April 1, 2016 – March 31, 2017**



(3) Number of Measurements





## 2016 Fresh Pond Reservation Class B Waters

**Table 1: Water Quality Results**

Date	Site	Alkalinity (mg CaCO <sub>3</sub> /L)	Al (mg/L)	Ca (mg/L)	Cl (mg/L)	Chl- <i>a</i> (mg/m <sup>3</sup> )	Color (CU)	DO (mg/L)	<i>E. coli</i> (MPN/100 mL)	Fe (mg/L)	Lab pH	<i>In situ</i> probe pH	Mn (mg/L)	Na (mg/L)
3/1/2016	Blacks Nook	48.5	0.0152	16.2	21.7	26.1	26	11.75	1	0.96	7.47	7.55	0.05	10.1
3/1/2016	LFP	51.5	0.0936	23.50	108	19.6	27	11.58	<1	0.72	7.58	7.77	0.1	50.4
3/1/2016	North Pond	96.5	0.0635	31.60	24.8	82.0	200	6.14	13	10.0	6.85	7.25	0.95	12.9
7/27/2016	Blacks Nook	50.3	0.0129	17.40	23.2	7.14	23	5.77	291	0.63	7.3	7.48	0.06	12.0
7/27/2016	LFP	57	0.0417	38.70	172	23.4	52	7.14	51	1.99	7.46	7.20	0.49	108
7/27/2016	North Pond	94.4	0.0819	77.60	31.5	30.4	67	0.29	4	41.5	8.75**	7.20**	3.76	19.0
11/2/2016	Blacks Nook	59.0	0.0087	23.50	32.5	7.17	22	7.59*	13	0.62	7.32	7.40*	0.06	14.0
11/2/2016	LFP	49.0	0.1995	49.54	203	14.8	30	10.07	4	12.2	7.42	7.51	0.30	142.4
11/2/2016	North Pond	60.5	0.0114	49.67	40.7	10.8	50	5.46	117	1.50	7.3	7.34	0.16	24.8
2/22/2017	Blacks Nook	56.0	0.4984	55.0	120	27.0	19	10.88	1	1.99	7.28	7.46	0.35	34.0
2/22/2017	LFP	46.0	0.0431	28.6	28.0	6.40	28	13.06	<1	0.42	7.25	7.84	0.11	69.0
2/22/2017	North Pond	100	0.0451	34.8	29.0	21.0	62	5.54	5	1.67	6.78	7.28	0.94	15.0

Anomalous data are highlighted in red.

\*Average of three *in situ* probe readings taken at 9:41 am, 12:04 pm, and 12:08 pm. The 9:41 am probe reading (3.6 mg/L) was in violation of the Class B water quality standard of 5 mg/L. However, the average of the three DO probe readings exceeded the Class B standard.

\*\*Lab pH unusually high; lab pH was also high relative to the *in situ* pH measurement taken with the multi-sensor probe.





**Table 1: Water Quality Results cont.**

Date	Site	NH <sub>3</sub> (mg/L)	NO <sub>3</sub> (mg/L)	Lab SpC (uS/cm)	<i>In situ</i> probe SpC (uS/cm)	Total Dissolved Solids (mg/L)	Water Temperature (degrees C)	TKN (mg/L)	Total Organic Carbon (mg/L)	Total Phosphorus (mg/L)	Turbidity (NTU)
3/1/2016	Blacks Nook	<0.05	<0.005	149	171.6	109.8	6.33	0.48	5	0.04	2.87
3/1/2016	LFP	0.09	0.025	421	471.8	302	6.95	0.67	4.4	0.04	2.77
3/1/2016	North Pond	0.10	<0.005	226	268.5	171.8	6.68	1.3	11.7	0.14	23
7/27/2016	Blacks Nook	0.08	0.010	174	187.9*	120.2*	26.88*	0.57	6.7	0.03	1.94
7/27/2016	LFP	0.10	<0.005	711	728.2	466.1	27.98	0.94	4.4	0.07	9.56
7/27/2016	North Pond	0.17	<0.005	276	330.2	211.3	23.73	3.0	16.6	0.02	7.84
11/2/2016	Blacks Nook	0.09	0.020	237	230.4	147.4	10.2	0.54	5.5	0.02	1.98
11/2/2016	LFP	0.18	0.025	712	776.1	496.7	10.55	0.85	3.8	0.05	4.03
11/2/2016	North Pond	0.24	0.034	370	400	147.4	9.55	1.1	12.2	0.03	5.13
2/22/2017	Blacks Nook	0.12	<0.050	199	209.7	134.2	1.61	0.73	5.6	0.06	3.5
2/22/2017	LFP	0.06	<0.050	444^	603.5^	386.2	3.35	0.56	4.7	0.02	4.08
2/22/2017	North Pond	0.05	0.052	353	304.6	194.9	2.03	1.1	11.8	0.08	4.09

Anomalous data are highlighted in red.

\*Average of three *in situ* probe readings taken at 9:41 am, 12:04 pm, and 12:08 pm.

^Large difference between *in situ* probe reading and result measured from water quality sample in the lab.